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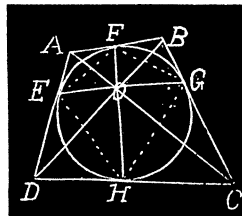
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196. Proposed by HARRY S. VANDIVER. Bala. Pa..

If a quadrilateral circumscribe a circle, the two diagonals and the two lines joining the points where the opposite sides of the quadrilateral touch the circle will all four meet in a point.

I. Solution by J. R. HITT, Principal. Liberty High School. Goss. Miss.; and G. B. M. ZERR, A. M., Ph. D., The Temple College, Philadelphia, Pa.

Let the diagonals of $ABCD$ meet in O , and let EG , FH meet in O' . FG , EH are the polars of B , D , respectively. Hence, BD is the polar of the intersection of FG , EH . Likewise is AC the polar of intersection of EF , GH . Therefore, O is the pole of third diagonal of $EFGH$. But O' is the pole of the third diagonal of $EFGH$, since the diagonal triangle is self-conjugate with respect to circumscribing circle. Hence O , O' , coincide, and the proposition is proved.



II. Solution by G. W. GREENWOOD, A. B., Professor of Mathematics. McKendree College, Lebanon, Ill.

We can project the given quadrilateral into a parallelogram circumscribing an ellipse, in which it is easily seen that the lines joining the points of contact of the opposite sides, and the diagonals of the parallelogram all meet in the center, and that these lines in the original figure are concurrent.

Also solved by L. C. WALKER, and L. L. LOCKE.

CALCULUS.

161. Proposed by J. C. NAGLE, M. A., M. C. E., Professor of Civil Engineering in the Agricultural and Mechanical College of Texas, College Station, Texas.

A cylindrical oil tank of length l and radius r is capped by curved ends and rests with the axis horizontal. The total length of the tank is $l+2h$. If the oil stands at depth d in the tank (d less than $2r$) find its volume (a) when the ends are portions of the surface of a sphere, (b) when the ends are portions of the surface of an ellipsoid.

Solution by G. B. M. ZERR, A. M., Ph. D., Professor of Chemistry and Physics. The Temple College, Philadelphia, Pa.

Let $y^2 + z^2 = 2ry$, be the equation to the cylinder. Then $z = \sqrt{2ry - y^2}$.

$$\therefore V = 2l \int_0^d \sqrt{2ry - y^2} dy = \frac{l}{2} \left[\pi r^2 + 2(d-r)\sqrt{2rd - d^2} + 2r^2 \sin^{-1} \left(\frac{d-r}{r} \right) \right].$$

If $d=2r$, $V=\pi r^2 l$.

(a). Let $x^2 + y^2 + z^2 = R^2 = [(r^2 + h^2)/2h]^2$, be the equation to a sphere, a portion of whose surface forms the ends of the tank.

$\therefore z = \sqrt{R^2 - y^2 - x^2}$, the limits of x are $(R-h)$ and $\sqrt{R^2 - y^2}$; of y , $-r$ and $d-r$. Let V_1 = the volume of both ends.